

CLAIMS

What is claimed is:

1. A method of making cast shapes such as complex shapes with thin walled configurations as well rings, tubes and pipes with smooth or contoured profiles on the outside diameter of titanium base alloys, comprising:

- a) melting the alloy under vacuum or partial pressure of inert gas;
- b) a set of steps selected from the group consisting set I of steps and set II of steps:

wherein Set I of steps comprises pouring the alloy into a cavity of a cylindrical mold rotating around its own axis, wherein the mold is made of machined graphite, wherein the graphite has been isostatically or vibrationally molded and has ultra fine isotropic grains between 3-40 micron, a density between 1.65 and 1.9 grams/cc, flexural strength between 5,500 and 20,000 psi, compressive strength between 12,000 and 35,000 psi, and porosity below 15%,

wherein Step II of steps comprises pouring the alloy into a central sprue, the central sprue rotating along a vertical axis of the central sprue wherein the melt travels under the action of centrifugal force radially outward through horizontal runners into cavities of molds spinning along the circumference of a circle of rotation and, wherein each mold is made of machined graphite, wherein the graphite has been isostatically or vibrationally molded and has ultra fine isotropic grains between 3-40 micron, a density between 1.65 and 1.9 grams/cc, flexural strength between 5,500 and 20,000 psi, compressive strength between 12,000 and 35,000 psi, and porosity below 15%; and

- c) solidifying the melted alloy into a solid body taking the shape of the respective mold cavity.

2. The method of Claim 1, wherein the metallic alloy is titanium alloy and titanium aluminide alloy.

3. The method of Claim 1, wherein the metallic alloy is based on titanium and contains at least about 50% Ti and at least one other element selected from the group consisting of Al, V, Cr, Mo, Sn, Si, Zr, Cu, C, B, Fe and Mo, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

4. The method of Claim 1, wherein the metallic alloy is titanium aluminide based on titanium and aluminum and containing 50-85% titanium, 15-36 % Al, and at least one other element selected from the group consisting of Cr, Nb, V, Mo, Si and Zr and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

5. The method of Claim 1, wherein the alloy is melted by a method selected from the group consisting of vacuum induction melting and plasma arc remelting.

6. The method of Claim 1, wherein the mold has been isostatically molded.

7. The method of Claim 1, wherein the graphite of the mold has isotropic grains with grain size between 3 and 10 microns, and the mold has flexural strength greater than 7,000 psi, compressive strength between 12,000 and 35,000 psi, and porosity below 13 %.

8. The method of Claim 1, wherein the mold has a density between 1.77 and 1.9 grams/cc and compressive strength between 17,000 psi and 35,000.

9. The method of Claim 1, wherein the mold has been vibrationally molded.

10. The method of Claim 1, where the mold is rotated along its own axis either horizontally or vertically or at an inclined angle under vacuum or under partial pressure of inert gas while the molten alloy is being poured into the mold.

X 11. The method of Claim 1, wherein Step II is employed, wherein a collection of the molds located along the perimeter of the circle on a horizontal plane are rotated, wherein melt is poured into the central sprue lying along the vertical axis at a center of the rotation, and wherein the melt is fed radially into respective mold cavities via the runners.

12. The method of Claim 1, wherein the cavity is machined into the inside surface of the cylindrical mold that will allow fabrication of casting with contoured profile on the outside diameter.

13. The method of Claim 1, wherein a coating of either hafnium carbide or tantalum carbide or tungsten or rhenium is deposited on the surface of the cavity.

14. The method of Claim 1, wherein the cavity is a machined cavity and a thin coating of either hafnium carbide or tantalum carbide or tungsten or rhenium is deposited on the surface of the machined cavity via either chemical vapor deposition or plasma assisted chemical vapor deposition, or sputtering.

14. The method of Claim 1, wherein the thickness of the coating of hafnium carbide, tantalum carbide, tungsten or rhenium on the surface of the cavity of the mold is from 2 to 200 microns.

15. The method of Claim 1, wherein the thickness of the coating of hafnium carbide, tantalum carbide, tungsten or rhenium on the surface of the cavity of the mold is from 7 to 100 microns.

16. The method of Claim 1, wherein the thickness of the coating of hafnium carbide, tantalum carbide, tungsten or rhenium on the surface of the cavity of the mold is from 10 to 25 microns.

17. The method of Claim 1, wherein the mold is made of modular molds of isotropic graphite and assembled with removable and stationary cores made of isotropic graphite.

18. The method of Claim 1, wherein the mold is made of isotropic graphite and assembled with stationary and sacrificial cores with thin walls made of isotropic graphite.

19. A centrifugal casting apparatus for casting metal products comprising,
a central sprue for rotating along a vertical axis of the central sprue,
isotropic graphite molds which have cavities,
horizontal runners for passing a melt there through under the action of centrifugal force radially outward into the cavities of the molds spinning along a circumference of a circle of rotation,
and

means for rotating the isotropic graphite molds.

20. A centrifugal casting apparatus for casting metal products comprising,
a central sprue for rotating along a vertical axis of the central sprue,
isotropic graphite molds which have cavities,
horizontal runners for passing a melt there through under the action of centrifugal force radially outward into the cavities of the molds spinning along a circumference of a circle of rotation,
and

means for rotating the isotropic graphite molds and
means for disassembling the mold under vacuum and ejecting the casting from the mold cavity when the casting has solidified to a temperature which is below the solidus temperature of the alloy and yet lies within less than 200°C below solidus temperature.

21. The apparatus of Claim 18, wherein the isotropic graphite mold comprises machined graphite, wherein the graphite has been isostatically or vibrationally molded and has ultra fine isotropic grains between 3-40 micron, a density between 1.65 and 1.9 grams/cc, flexural strength between 5,500 and 20,000 psi, compressive strength between 12,000 and 35,000 psi, and porosity below 15%.

22. The apparatus according to claim 18, wherein the isotropic graphite mold comprises at

least two isotropic graphite portions which are releasably attached to each other such that a metal product cooled within the mold can be removed from the mold.

23. The apparatus according to claim 18, wherein a coating of either hafnium carbide or tungsten or rhenium is deposited on the surface of each cavity.

22. A centrifugal casting apparatus for casting metal products comprising, an isotropic graphite mold having a cavity, and means for rotating the isotropic graphite mold, wherein a coating of either hafnium carbide or tungsten or rhenium is deposited on the surface of the cavity.

23. The apparatus according to claim 21, wherein the isotropic graphite mold comprises at least two isotropic graphite portions which are releasably attached to each other such that a metal product cooled within the mold can be removed from the mold.